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Illustrated Description

OF THE

BROADWAY

PNEUMATIC

UNDERGROUND RAILWAY.

WITH A

Full Description of the Atmospheric Machinery and the Great Tunneling Machine.

New-York:
S. W. GREEN, PRINTER, 16 & 18 JACOB STREET.
1870.

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GENERAL DESCRIPTION

OF THE

BROADWAY PNEUMATIC UNDERGROUND RAILWAY,

ÆOLOR, TUNNELING-MACHINE, ATMOSPHERIC PASSENGER-CAR, ETC., ETC.

ENTRANCE AND TICKET-OFFICE.

The present entrance to the Underground Railway is at the south-west corner of Broadway and Warren street, through the basement portions of the large and splendid marble edifice known as Devlin's building.

Descending a few steps from the sidewalk, the visitor enters the ticket-office, where the attention is at once arrested by the æolor or blowing-engine, which generates the air-blast by which the pneumatic cars are propelled.

This immense æolor is by far the largest machine of the kind ever made. It consists of a great shell of strong iron, twenty-one and a half feet high, sixteen feet long, and thirteen feet wide, containing two pairs of massive wings, geared together by cog-wheels, and so arranged that the air is drawn in upon one side of the machine, carried through between the wings, and forced out on the other side. We give a sectional view of the æolor, showing the form of the wings.



Sectional Elevation of the Great Æolor.

This remarkable machine weighs fifty tons, or rather more than a common locomotive engine. The æolor is to the pneumatic railway what the locomotive is to the ordinary steam railroad. The locomotive supplies the power to draw the car; the æolor gives motive force to the air by which the pneumatic car is moved.

The æolor is capable of discharging over one hundred thousand cubic feet of air per minute, a volume equal in bulk to the contents of three ordinary three-story dwelling-houses. The machine makes sixty revolutions per minute.

It is by the enormous air-current generated by such machines that trains of cars are impelled upon the atmospheric railway at speeds of from sixty to one hundred miles per hour.

The present æolor was made by the patentees, Messrs. P. H. & F. M. Roots, at their large establishment in Connersville, Ind. Its cost, set up complete, was about $20,000, and for its transport from Indiana to New-York, a train of five large platform-cars was required. The machine bears the appropriate name of "The Western Tornado." The Messrs. Roots are manufacturers of a great variety of sizes of these blowing-machines, and they are extensively used in iron-melting furnaces, cupolas, etc., in all parts of the country; the smallest pattern, for blacksmiths' forges, hardly exceeds the size of a man's hat. It takes the place of the common bulky leather bellows, is turned by a crank, runs easier than the bellows, and delivers more air. Other sizes are used for blast-furnaces. Mr. S. S. Townsend, No. 31, Liberty street, New-York, is the general agent.

The upper portion of the æolor, as seen in the ticket-office, is beautifully decorated, and presents no outward indication of being the great reservoir of

power we have just described. To realize this fact, we must go down-stairs and look within its capacious mouths.

Leaving the ticket-office and passing the æolor on the left, we enter the

WAITING-ROOM OF THE BROADWAY UNDERGROUND RAILWAY.

This is a large and elegantly finished apartment, commencing at Broadway and extending down Warren street for a distance of one hundred and twenty feet, built wholly under ground. The walls are handsomely finished and adorned with interesting pictures, while comfortable settees, looking-glasses, fountains, saloons for ladies and gentlemen, and other furnishings, render the place at once cheerful and attractive.

At the east end of the waiting-room we descend a half-dozen steps, and find ourselves upon the railway platform, near the portal of the tunnel, and at the door of

THE PNEUMATIC PASSENGER-CAR

One of our views shows the interior of the c is of circular form, richly upholstered, and ver fortable, with seats for twenty-two persons. terior height is greater than the cars of the L underground railways.

The pneumatic car is lighted with gas, wh compressed into small metallic cylinders by of powerful pumps. The cylinders are carri the platforms of the car. The gas, when it from the cylinders, is made to pass through a vessel containing a light petroleum oil, and th



THE PASSENGER-CAR.

is thus charged with carbon, which increas brilliancy of the gas-light.

In the operation of pneumatic railway-ca air-current impinges against one end of the as the wind presses against the sail of a bo car is thus driven along with a velocity co ing to the power of the air-current. The p cars may be run in trains, like steam cars, rately, if desired. Collision between p

trains or single cars is impossible, as there is always present, between each train or car, a column of air, which prevents the cars from coming together.

The ventilation of the pneumatic car is very perfect, as there is always a strong current of pure air blowing through the tunnel; and by turning registers, the air is admitted to the interior of the car.

The *Scientific American* very justly says that



PORTAL OF THE BROADWAY TUNNEL.

"Those who fancy that underground railway riding in New-York is likely to be a dark and dismal affair will receive new impressions on the subject when they enter the premises connected with the Broadway tunnel."

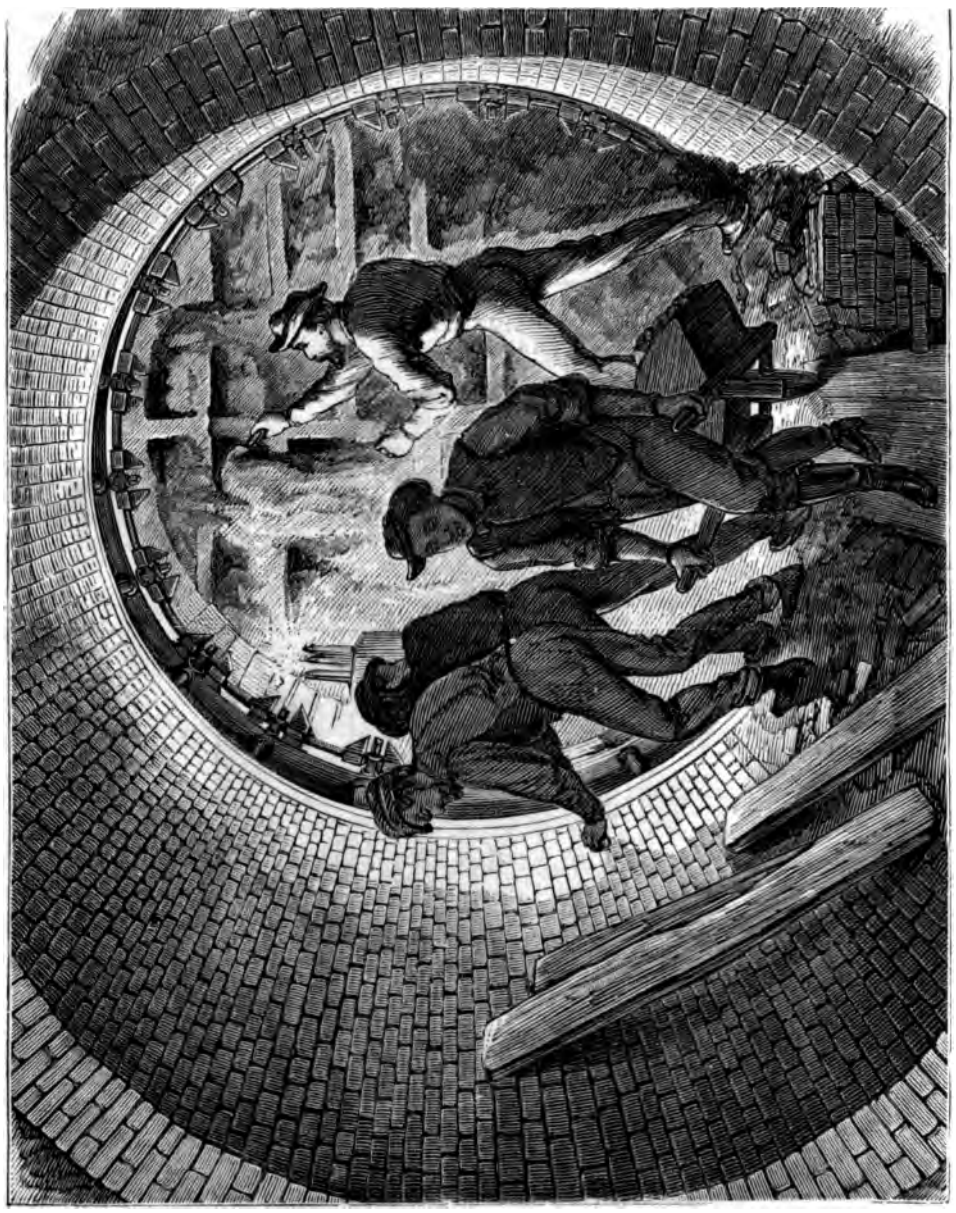
Leaving the passenger-car, let us take a look at

THE TUNNEL UNDER BROADWAY,

the portal of which, massive and ornamental, of circular form, stands before us as we face the east.

We will follow the railway track into the tunnel, and explore the underground mysteries of Broadway. The rumbling noise of the vehicles which pass in endless procession, directly over our heads, can be distinctly heard.

The tunnel commences at the curb-line of Broadway, and sweeps on a graceful curve a little beyond the centre line of the street; thence on a straight line down Broadway to a point a little beyond the south side of Murray street. The bed of the tunnel is twenty-one and a half feet below the pavement. The interior is painted white; it is lighted with gas and the brilliant zircon lights; is dry; the atmosphere is pure; and a walk through it will be found interesting and instructive. The length of the tunnel is three hundred and twelve feet, of which the curved portion, sixty feet, is built of iron plates, the interior diameter being nine feet. Standing upon the track platform, at a little distance from the tunnel, and looking within the portal, the iron walls, with their net-work of gracefully curved ribs, present a very pleasing appearance. This method of erecting iron tunnels is the invention of Mr. Joseph Dixon, the secretary of the company, long known for his persevering efforts to establish the underground railway in New-York.



ADVANCING THE SHIELD—INTERIOR OF THE TUNNEL.

The preceding view gives an idea of the appearance of the tunnel from the point just mentioned.

Following the track down the tunnel, we come to the masonry portion, which is eight feet interior diameter. The iron track, of the usual T pattern, rests upon longitudinal beams of wood, secured to the brick walls, and fastened cross-wise at intervals by flat girders of cast-iron.

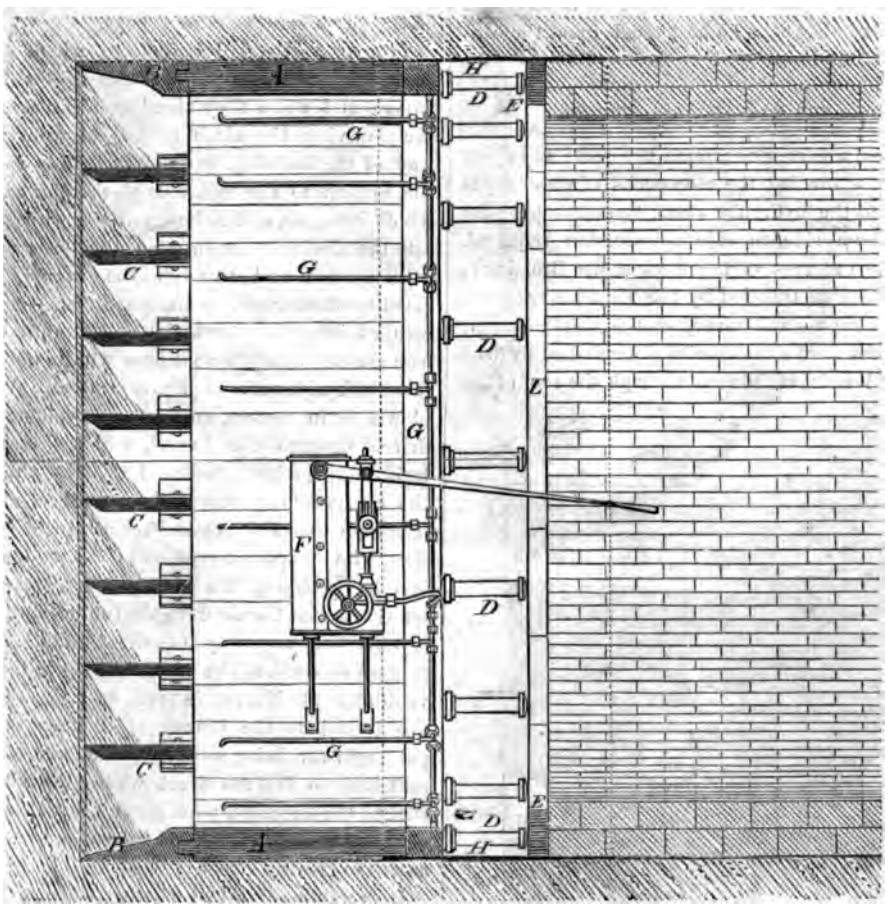
Telegraph wires extend along the walls of the tunnel, which are so arranged in connection with the track that the wheels of the car, when the latter reaches the ends of the tunnel, send back a telegraph signal to the engineer, who shifts an air-valve, whic reverses the air-current and causes the car to mov back to its starting-place. Proceeding down Broad way to the end of the tunnel at Murray street, w come to the

GREAT TUNNELING MACHINE OR SHIELD,

by which Broadway was bored without any bod knowing it, with all the omnibuses and other vehic traveling directly above the heads of the workmen.

We present two views of this novel mechanism, c

of which shows the workmen engaged in driving the machine ahead; the other a sectional diagram, showing the details of construction. The shield consists of a large cylinder, open at both ends, with shelves arranged within the front end to receive the earth and prevent it from falling too rapidly into the shield; at the rear of the latter, placed around its periphery, is a series of powerful hydraulic rams, eighteen in number, all connected with a single water-pump. From the rear ing the shield forward into the soil. As the shield advances, the earth presses through between the shelves, and falls down upon the bottom of the shield, whence it is removed in barrows and cars. As soon as the shield has been advanced sixteen inches, its movement is stopped, and a new section of the masonry tunnel is erected within the hood. The shield is then again pushed forward, and so on. By means of this machine, tunnels of all kinds and



A—Body of the Shield. B—Cutting Edge. C—Shelves. D—Hydraulic Rams. E—Bearing Block. F—Water Pump. G—Pipes from Pump to Rams. H—Hood. I—Brick Tunnel.

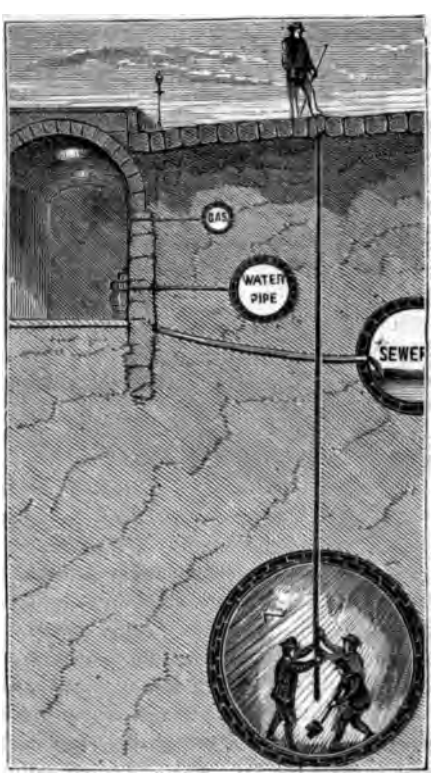
SECTION OF THE GREAT TUNNELING MACHINE.

of the shield, and passing entirely around it, extends a hoop or band of sheet steel, two feet wide, and one eighth of an inch thick, termed the hood. The brick tunnel is erected within this hood, which at all times covers the end of the masonry, and prevents the earth from falling upon the workmen. After a section of the tunnel sixteen inches long has been erected within the hood, the pump is operated, which causes the rams to slide out from the shield, and push with great force against the front edge of the tunnel, driv- sizes may be quickly constructed under the streets without disturbing the travel of vehicles over the surface. The shield may be readily moved around curves or on grades. Where tunneling at any considerable depth below the surface is required, the use of this machine saves a large amount of labor. Eight men, working with two of these machines, are enabled to excavate the earth and erect within the excavation eight running feet of completed tunnel per day.

This machine was designed by Mr. A. E. Beach, of the *Scientific American*, and was built by the Holske Machine Company, 528 Water street, under the personal superintendence of Mr. William F. Holske. The splendid hydraulic rams and pump were made at the celebrated hydraulic engineering establishment of E. Lyon, 470 Grand street, New-York, from the drawings and under the special superintendence of Mr. Thomas G. Watson, mechanical engineer. The system of hydraulic rams used in this tunneling machine is worthy of special note for its novelty and success. It reflects the highest credit upon the constructor and engineer.

How the machine was steered.

The shield was steered around the curve and down Broadway by turning the stop-cocks of water-pipes belonging to the hydraulic rams, thus changing the pressure from side to side as occasion required. During the progress of the work under Broadway, the exact course traveled by the shield was determined by compass and survey in the usual manner, and the lines were from time to time verified by driving jointed rods of iron up through the roof of the tunnel to the pavement, as indicated in our sketch. This was done in the night-time, after the stages had ceased running.



Testing the Position at Night.

HOW THE CAR IS OPERATED.

Having presented a general description of the tunnel, the car, and the æolor or blowing-machine, we will now briefly describe the manner in which the car is operated. To do this intelligently, reference should be made to the engraving of the general plan of the premises on the next page.

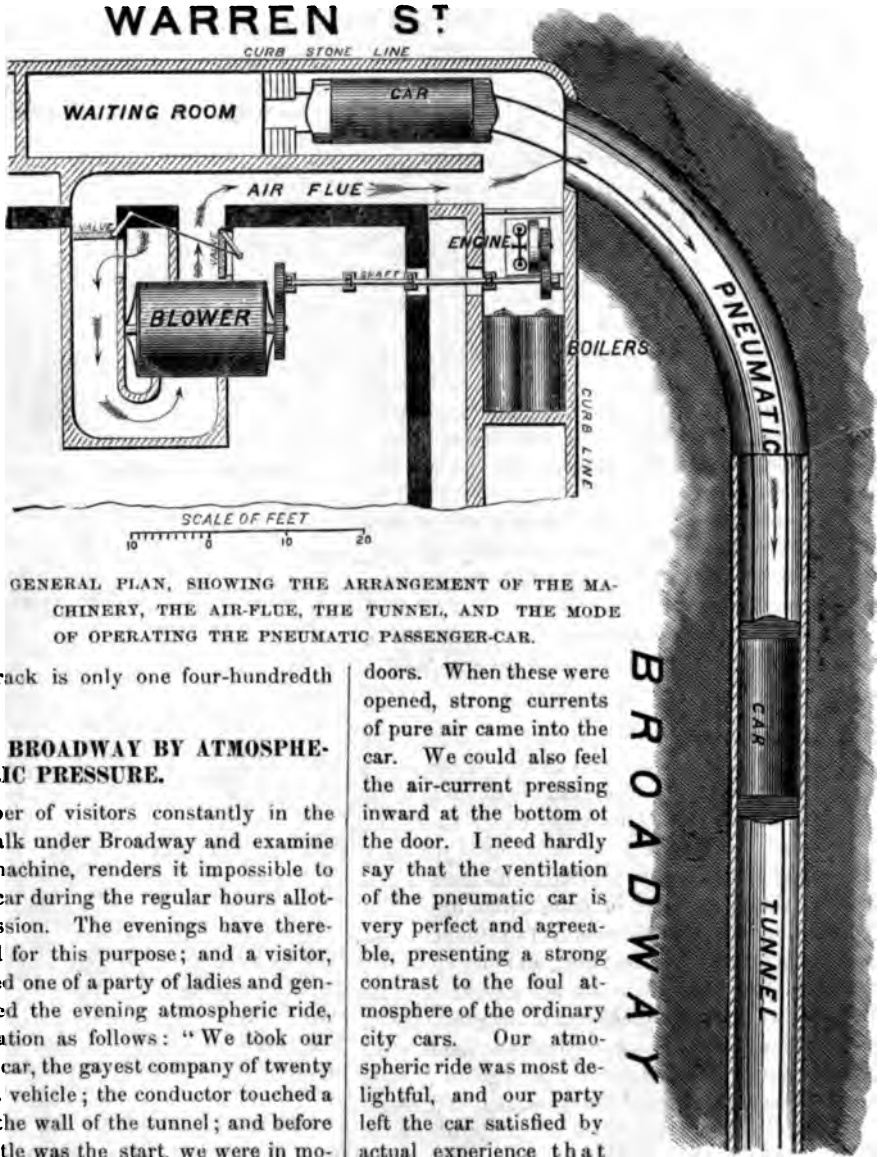
Two air-valves will be noticed, which operate in connection with the air-passages of the blower or æolor; and when they stand in position shown in the plan view, the air is sucked in from the area-way of the building, and moves in the direction of the arrows to the back side of the blower, through which it passes, and is thence driven with great force into the air-flue down through the lower end of the waiting-room and through the tunnel, as indicated by the arrows, to Murray street, where the air escapes into the street through a ventilator. The iron grating over the ventilator will be noticed upon the Park sidewalk at Murray street. When the blower is in motion, an enormous volume of air is driven through the tunnel, which drives the car before it like a boat before the wind. On arrival of the car at Murray street, the car-wheel strikes the telegraph wire and sends back a signal to the engineer, who shifts the position of the two air-valves, thereby reversing the air-current by causing the blower to suck the air from the tunnel, and discharge it into the area-way of the building. In this process of suction the air is drawn in through the ventilator at Murray street and passes through the tunnel to the blower at Warren street, the passenger-car being swept by the force of the current back to Warren street, where the wheel again strikes the telegraph wire, gives a signal to the engineer, who again moves the valves, and back the car moves to Murray street.

It is frequently asked whether the passing of the air-current directly into the waiting-room does not make the apartment uncomfortable, by producing therein an undue air pressure, or strong draughts. A little consideration will show that there can be no such difficulties. The waiting-room, or station, is built entirely underground, and there can be no leakage of air through it, except when the entrance-doors are thrown open. These are double doors, and when one is open the other is closed, all leakage of air being thus prevented. The atmosphere of the station or waiting-room is, therefore, not disturbed by the rush of air to and from the tunnel, and the visitor is not aware that an alternate compression and exhaustion of the air is going on within the sta-

ion, unless the ye rests upon the pressure-gauge which hangs upon the wall, the rise and fall of which exhibits the changing pressure.

The car runs so easily upon the track that only a few grains of atmospheric pressure to the square inch are sufficient to move the car with a considerable velocity. This pressure is so small that the visitor within the station does not perceive it.

The friction of a car upon a level track is only one four-hundredth part of the load.



GENERAL PLAN, SHOWING THE ARRANGEMENT OF THE MACHINERY, THE AIR-FLUE, THE TUNNEL, AND THE MODE OF OPERATING THE PNEUMATIC PASSENGER-CAR.

A RIDE UNDER BROADWAY BY ATMOSPHERIC PRESSURE.

The great number of visitors constantly in the tunnel, eager to walk under Broadway and examine the great boring-machine, renders it impossible to run the passenger-car during the regular hours allotted for public admission. The evenings have therefore been reserved for this purpose; and a visitor, who recently formed one of a party of ladies and gentlemen who enjoyed the evening atmospheric ride, describes the sensation as follows: "We took our seats in the pretty car, the gayest company of twenty that ever entered a vehicle; the conductor touched a telegraph wire on the wall of the tunnel; and before we knew it, so gentle was the start, we were in motion, moving from Warren street down Broadway. In a few moments the conductor opened the door, and called out, '*Murray street!*' with a business-like air that made us all shout with laughter. The car came to a rest in the gentlest possible style, and immediately began to move back again to Warren street, where it had no sooner arrived, than in the same gentle and mysterious manner it moved back again to Murray street; and thus it continued to go back and forth for, I should think, twenty minutes, or until we had all ridden as long as we desired. No visible agency gave motion to the car, and the only way that we upon the inside could tell that we were being moved by atmospheric pressure was by holding our hands against the ventilators over the doors. When these were opened, strong currents of pure air came into the car. We could also feel the air-current pressing inward at the bottom of the door. I need hardly say that the ventilation of the pneumatic car is very perfect and agreeable, presenting a strong contrast to the foul atmosphere of the ordinary city cars. Our atmospheric ride was most delightful, and our party left the car satisfied by actual experience that the pneumatic system of traveling is one of the greatest improvements of the day.

"Having thus described our experience in the car, I ought now to tell you how it was done. You must know then that a telegraph wire runs through the tunnel, which is so connected with the track that the wheels of the car touch the wire at certain points, and cause a bell to be sounded in the main building, where the æolor, or blowing-engine, is situated; and when the engineer hears the bell, he pulls a rope, which operates an air-valve, so as to let in or change the air-current in the tunnel. For example, just before our car stopped at Murray street, the wheel of the car sent the signal to the engineer, who shifted the valve, when instantly the blowing current was chang-

ed to a suction current, which drew us back to Warren street; and just before we arrived there, by another signal, the current was again changed, and down we went to Murray street.

"The air presses directly against the end of the car, and we were carried along just like a sail-boat before the wind. A car mounted on a track is moved much easier than a boat upon the water, because the vessel encounters great resistance in displacing the water, while the car merely has to overcome the friction of the wheels, which is only one four-hundredth part of its weight. Therefore only a small air pressure is required to drive a pneumatic car with a high velocity. An atmospheric pressure of one quarter of an ounce to the square inch, is sufficient to drive the car forty or fifty miles per hour. At the time of our ride, the velocity was perhaps six or seven miles an hour, and the air pressure was only a few grains to the inch.

"I ought to mention that down near Murray street there is a ventilator extending from the tunnel to a grating on the sidewalk, through which the air column enters and leaves the tunnel.

"I must not omit to tell you of our experience inside of the air-ducts, where the air-blast issues.

THE WESTERN TORNADO.

"After we had had our ride, it was only natural of course, that we should wish to explore the source from whence came the pneumatic pressure that had so mysteriously carried us along under Broadway. Accordingly, under the guidance of one of the polite officials of the company, provided with lanterns, we entered the air-passage, or duct, which opens into the waiting-room near the mouth of the tunnel. This passage is fifty or sixty feet long, and four and a half feet high. As we went in, we felt a gentle breeze; but after we arrived at the mouth of the great blower, and while we were gazing in wonder at the motions of the gigantic blowing-wings, the engineer put on more steam and increased the speed, so that the blast instantly *became a hurricane of frightful power.* Hats, bonnets, shawls, handkerchiefs, and every loose thing, were snatched away from our hands and swept into the tunnel; while all of us, unable to stand against the tornado, hastily retreated from the machine to a corner of the air-box, where we were slightly sheltered. At this juncture the speed of the æolor was reduced, the storm was over, and only a gentle summer's breeze issued from its enormous throat. We retired from the presence of the machine, some of us thoroughly frightened, and thankful that it did not quite blow the life out of us. We had heard that New-York was a great place for blowers' of various kinds; but of all the devices in this line, the palm belongs to the great æolor of the underground railway."

HOW THE CARS STOP AT WAY-STATIONS.

Another of our views shows the interior of a small passenger way-station, and illustrates the method of stopping and starting the trains. The tunnel, as it approaches the station, is enlarged, so that air may pass the cars, the speed of which is diminished by the application of brakes. The cars are brought to a halt within the station, and remain standing upon a slight down-grade, while the air current from one branch of the tunnel continues on through the station into the other branch of the tunnel. On releasing the brakes, the force of the air impinging against the rear car, assisted by the grade, gently starts the train forward into the mouth of the tunnel, where it receives the full force of the air-current, and is driven onward to the next station.

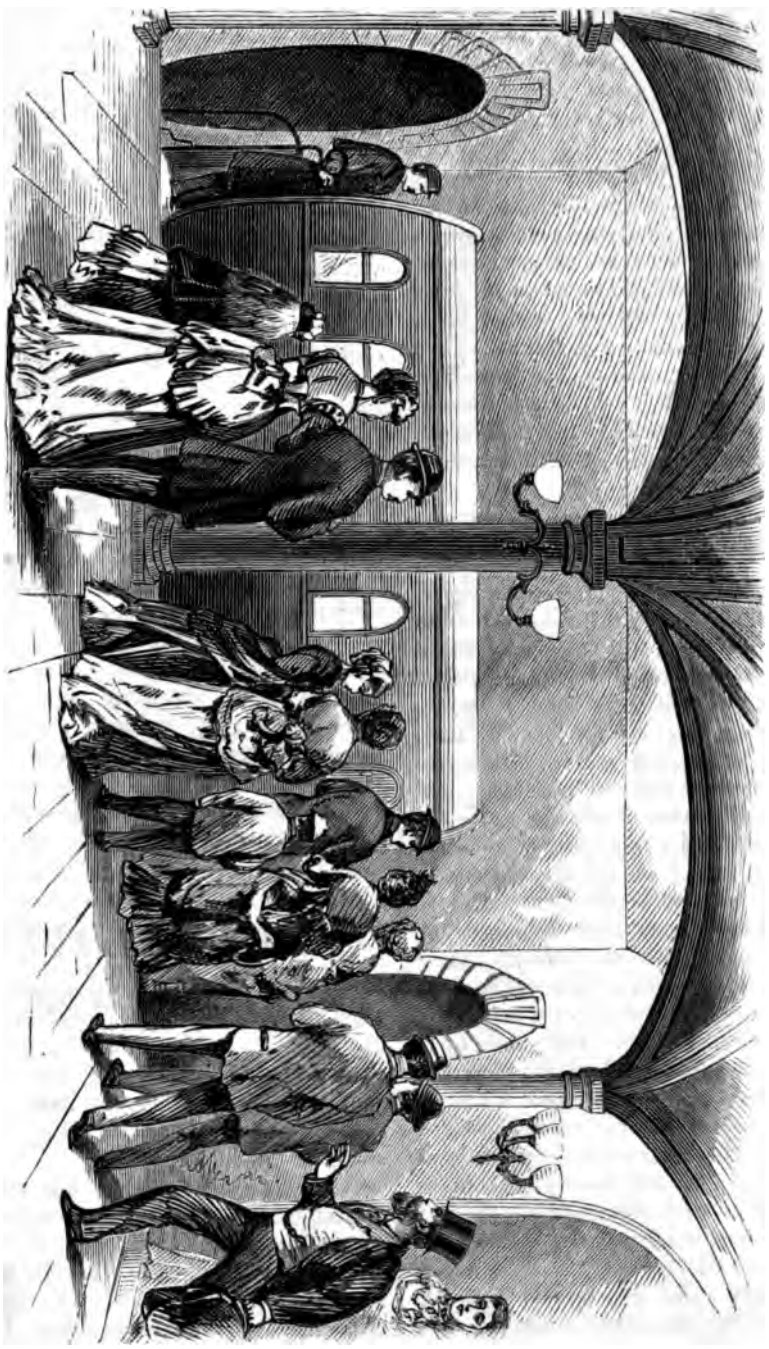
HOW THE TUNNEL CAME TO BE BUILT.

The present tunnel under Broadway has been constructed under the auspices of the Beach Pneumatic Transit Company, a corporation chartered in 1868, with authority to convey letters, parcels, and merchandise through tubes not to exceed fifty-four inches mean interior diameter. It was ascertained by the company, after careful investigation, that the cost of laying down two tubes of the above size, constructed together, would be but little more than that of building a single tube. It was also ascertained that the quickest and best method of construction for the two tubes was to bore under the streets, below the water-pipes and sewers, and erect a masonry shell or tunnel large enough to inclose both of the fifty-four-inch tubes. It is a portion of this outer tunnel that has been erected; and as it proves to be strong enough and large enough for the transit of passengers, it is to be hoped that the company will be compelled by law to omit their intended division wall, and open their tunnel for passenger traffic.

CARRYING CAPACITY OF THE PNEUMATIC RAILROAD.

"We have," says *Frank Leslie's Newspaper*, "made a little calculation on this point, and find that with two tubes such as that already erected, but perhaps a trifle larger, and with trains starting every two minutes, the company could carry from ten to fifteen thousand passengers per hour from Harlem River to the South Ferry, and probably double that number, should it ever become necessary. At a comparatively moderate rate of speed, the time occupied in traveling the whole distance would not exceed twenty minutes.

"The company are now by law required to erect receiving-boxes upon the side-walks for the public convenience in depositing letters and packages for



A PNEUMATIC WAY-STATION.

dispatch in their pneumatic tubes, which is all very well. But what the people more imperatively need is the provision of facilities for carrying passengers with comfort and speed. This can be readily done under the pneumatic system, and therefore we think that the company ought to be compelled by law to do it, and the sooner the better."

We are indebted to *Frank Leslie's Newspaper* for engravings illustrating the Broadway Tunnel and machinery.

THE STEAM-ENGINE.

The Pneumatic Company's Steam-Engine is rated nominally at 100 horse-power, but has really a greater capacity. It is of the kind known as the tumbling beam engine; has two upright cylinders. It is the invention of Norman A. Wheeler, who is known as one of our best mechanical engineers. Engines of this kind take up but little space, and are used on some of our steam-vessels. The form and movements of the engine are peculiar. It was built by the Holske Machine Company, No. 528 Water street, New-York.

STEAM BOILERS.

To reach the boiler and engine-room, we pass through the door-way near the portal of the tunnel, on the south side, and here we find, located under the pavement of Broadway, two large and splendid steam boilers, made by Joseph A. Miller & Co., of Boston, Mass. These boilers, although nominally of 100 horse-power, are capable of furnishing steam for a 200 horse-power engine. Their construction is novel and peculiar. Their front portions consist of strong steam separator and water chambers, from which latter project, on the rear, a large number of strong wrought-iron tubes, the back ends of which are closed solid. Each of these tubes contains a small inner tube of brass, which extends from a diaphragm within the water-chamber, nearly to the end of the wrought-iron tube. The object of the inner tubes is to promote the rapid circulation of water. The wrought-iron tubes are completely inclosed in an oven of fire-bricks, so that the heat generated from the fuel is applied to the tubes in the most effective and economical manner. The fronts of the boilers are handsomely finished, provided with Miller's patent doors, gauges, safety-valves, blow-cocks, etc. It seems to be the general opinion of all engineers who have examined these boilers that, for safety, economy of fuel, and convenience of working, they take the first rank. Mr. Joseph A. Miller, the patentee, has for many years made the generation and use of steam his especial study, and probably there are few engineers in the country who have a better knowledge of the subject, whether in its theoretical or practical aspects. These boilers were erected under h sonal supervision, bear his celebrated trade "In Calore vis," which may be found posted the boilers of many of the largest manufacto this country and Europe.

The Pneumatic Company's boilers present surface of fourteen square feet for each horse- All persons who desire to see the workings of are considered to be the latest and best im ments in this line are invited to examine thes ers closely. All work done by Messrs. Mille variably of the best and most reliable charact

THE STEAM-GAUGES.

We believe it is generally considered by eng that the mercurial gauge is the most desirable liable. But until within a recent period it ha found impossible to provide a really conv of method adjusting the height of the mercur umn, when from temperature or other causes not correctly set within its glass tube. This di has been entirely overcome by the American Steam-Gauge Company, of Newark, N. J., w now turning out instruments of splendid ch and handsome appearance. These gauges ar upon the Pneumatic Company's boilers. At th of the mercurial column there is a small wheel by simply turning which, the column, if a may be at once adjusted to zero; and when s admitted, it will show the pressure with perf actness. The great importance of durable an ble steam gauges, and the well-known superio good mercury gauges, will no doubt lead to tensive introduction of the American Eagle Company's instruments.

NOTES FROM THE NEWSPAP

A VERY excellent description of the Pne Tunnel, with many illustrations, will be fo *Frank Leslie's Newspaper* of Feb. 19th, 1870.

Harper's Weekly for March 12th also pre good picture of the interior of the tunnel, from Warren street down Broadway toward street.

The *Scientific American* of March 5th als trates the tunnel with a number of engravir a good description.

The New-York *Tribune*, the New-York *S* the New-York *Herald* have also given illus of the tunnel. The greatest interest in the and progress of the work has been expressed press of New-York and Brooklyn, and a places. The almost universal desire of the pu the people is, that the Legislature will give th

pany the right to carry passengers, and cause the work to be extended throughout the city as quickly as possible.

On the 28th day of February, 1870, the tunnel was for the first time thrown open to the public, and has been daily thronged with visitors. To prevent too great a crowd, a charge of 25 cents is made. Many thousands of people have visited the tunnel, and their expressions of satisfaction at the complete and substantial character of the work, the solidity and excellence of the machinery, the simplicity and power of the atmospheric system, have been universal.

A memorial, asking the Legislature to grant to the company the right of carrying passengers, is in circulation, and has been signed by many thousands of the most influential and substantial citizens of New-York, Brooklyn, Westchester, and adjoining places.

From the Scientific American.

THE TUNNEL UNDER BROADWAY, NEW-YORK.

SOMETHING of a fragmentary and, in most respects' unreliable character has found its way into the daily papers relative to the important work now in progress under Broadway in this city, known as the Pneumatic Tunnel. So far as the accounts of some legal proceedings, to which the work has given rise, and its present extent, are concerned, the statements made by the journals are, in the main, correct; but the real scope of this important experiment, and the benefits which its successful completion are destined to confer upon the city itself, seem either not to be fully understood, or to be looked upon with incredulity.

We have said this is an important experiment. So far as the working of such a tube is concerned, it is not an experiment, but a well demonstrated fact. It is only an experiment in a financial and business point of view. That upon the completion of the tunnel and its opening to public transit a gratifying result will reward its projectors, we entertain no doubt whatever.

Although the President of the Beach Pneumatic Transit Company is one of the proprietors of the *Scientific American*, the writer of the present article visited the tunnel for the first time on the 8th of February. The day was stormy and the snow fell fast and heavy. Cars were with difficulty kept on the tracks in the streets. Umbrellas were in vain. The wind made no more of turning them inside out than of shaking dead leaves from the trees in the park. It was a favorable time to contrast the miseries and annoyances of street car travel with the comfort of tunnel transit.

Entering at the south-west corner of Warren street and Broadway, we were soon initiated into the mysteries of which so much has been made by the newspaper reporters. The simplicity of the principle of this mode of transit is not fully appreciated until one sees the thing itself.

Let the reader imagine a cylindrical tube eight feet in the clear, bricked up and whitewashed, neat, clean, dry, and quiet. Along the bottom of this tube is laid a railway track, and on this track runs a spacious car, richly upholstered, well lighted, with plenty of space for entrance and exit. The whole arrangement is as comfortable and cozy as the front basement dining-room of a first-class city residence. The tunnel has not only the positive comforts described, but it is absolutely free from the discomforts of surface car-travel. The track is smooth and level, and, not being subjected to incessant battering from heavy trucks, is easily kept in first-rate condition. It is not cold in winter. It will be delightfully cool in summer. The air will be constantly changed in it by the action of the blowing-engine. The filthy, health-destroying, patience-killing street dust, of which up-town residents get not only their fill, but more than their fill—so that it runs over and collects on their hats and clothes; fills their hair, beards, and eyes, and floats in their breaths like the vapor on a frosty morning—will never be found in the tunnel. Add to these advantages that of cheap, rapid, and uninterrupted transit, free from the dangers of collision with loaded trucks, and we have a pretty fair showing in favor of the tunnel over street railways.

When the tunnel is opened to the public, it will be no dirty hole in the ground the people will be invited to enter, but a handsome subterranean avenue, through which they may be rapidly transported to their homes up-town.

This system is in our opinion vastly superior to the subterranean steam transit under Broadway, as has been proposed. Its first cost is very much less. It is free from the smoke nuisance and from the dust of locomotives. There can be no accumulation of carbonic acid gas in it—an evil which may be estimated from the fact that for every pound of coal burned, three and one third pounds, or twenty-nine and one half cubic feet, of carbonic acid will be generated. Granted that this gas will find free exit from the area-ways, at the side of the street, so that people can breathe and live below, it will float off into the stores alongside, descend into the cellars, and become a general nuisance.

In the pneumatic system, the cars will be impelled by compressed air only. This air will be uncontaminated by gas or dust, the track will not be crushed and damaged by heavy locomotives, and all the discomforts of steam travel through tunnels will be eliminated.

The present apparatus in the basement of the building at the corner of Warren street and Broadway, comprises a stationary engine of one hundred horse-power, with boiler, and a Root's Pressure Blowing engine, capable of delivering to the tunnel one hundred thousand cubic feet of air per minute. We may on a future occasion give a more detailed account of this apparatus.

There is no doubt that this method of transit might be made not only the means of easy and rapid communication between the upper and lower parts of the island, but also between New-York and Long Island, and New-York and New-Jersey, through tubes underneath the North and East rivers. The relief which this would give to surface travel and the convenience it would afford to suburban residents, would increase the value of real estate, and greatly add to the comfort and luxury of metropolitan life.

From Frank Leslie's Newspaper.

THE BROADWAY PNEUMATIC TUNNEL.

THE series of engravings pertaining to the Pneumatic Railway which we this week present, illustrate the progress of a remarkable work, planned and executed in a remarkable manner. Our great metropolitan thoroughfare has been bored, arched, and a track laid down, by a corps of sappers and miners, who have operated with surprising rapidity and success. They have not only tunneled Broadway, but have done so with the surging throng of humanity, animals and vehicles, marching in endless procession directly above their spades. No outward indications of activity below the ground have been exhibited, and, until quite recently, the public has had no knowledge of the matter. The works are hidden by the granite pavement of the street, and but for our engravings, taken from the subterranean structures themselves, it might be difficult to satisfy our readers that we have above stated only the facts.

The Underground Railroad, the highway for rapid city transit, long needed and pressingly demanded by the inhabitants of New-York, has at last been commenced, and a short portion has been put in actual operation. We trust it will not be long ere we shall be able to chronicle the full completion of the work from the Battery to the Harlem River. It is evident, from the example now before us, that the construction of an underground railway in this city is not a difficult nor, necessarily, a tedious operation. Six months or a year's time is quite sufficient, the ways and means being provided, with enterprising men as conductors.

From the New-York Evening Mail, Feb. 26, 1870.

THE GREAT BORE.

COMPLETION OF THE FIRST SECTION OF THE BROADWAY UNDERGROUND RAILWAY—A GREAT SUCCESS.

The problem of tunneling Broadway has been solved. There is no mistake about it. Even as we write, a comfortable passenger-car is running smoothly and safely between Warren and Murray streets, demonstrating beyond contradiction that it is only a question of time and money to give us rapid and comfortable transportation from the Battery to Harlem and back again. Nearly three months ago *The Evening Mail* was the first journal in the city to announce the existence of this great bore beneath Broadway. In our columns were then described the progress of the work and enough of the plans of the projectors to give a clear idea of what the public were to expect from them. Since then the work has been pushed vigorously on by competent workmen, under a thoroughly competent superintendent, whose name is Dixon; may his shadow increase for evermore! This afternoon, pursuant to invitation, the completed section of the work will be prospected by the Mayor, and other members of the city government, and the leading capitalists of the city, and that this visit will be followed by a general hallelujah, no sane man doubts who has sat in that cozy car over twenty feet beneath the surface of Broadway, and been whiffed from Murray street to Warren before he had time to say "God bless you!"

* * * * * * * * *

We have said that the bed of the tunnel is twenty-one and a half feet beneath the surface of the street. It will then be understood that it is below both sewers, and water and gas pipes, and so far below them as neither to interfere or be interfered with.

The completed section illustrates satisfactorily that there is nothing now to be done but give this company such a charter as will enable them to go on with the passenger-carrying scheme. We can afford to wait awhile longer for the parcel tubes much better than we can bear the increasing discomforts of the surface railroads.

It is truly most gratifying to see how admirably successful the affair has been carried out so far, and so quietly as to excite no comment. There is the capacious waiting-room, one hundred and twenty feet long, for passengers, as perfect in its appropriateness as if it had been the starting-place for uptown for a dozen years. There is the snugly upholstered passenger car, illuminated with the brilliant lime light, the tunnel nearly three hundred feet in length, the engine and the monster fans—all under Broadway, and "nobody a bit the wiser," one might say.

From the New-York Herald, Feb. 27, 1870.

"UNDER BROADWAY."

PROPOSED UNDERGROUND RAILROAD—A FASHIONABLE RECEPTION HELD IN THE BOWELS OF THE EARTH—THE GREAT BORE EXPLORED.

"UP Broadway" and "Down Broadway" are familiar routes, familiar not only to Americans residing in New-York, but by description to all the inhabitants of the world. "Under Broadway" for two hundred and ninety-four feet, right away, in a thoroughfare well-lighted, in a scrupulously clean avenue, is not quite so familiar. Yesterday, hundreds of our citizens, including state officers, members of the Legislature, city officials, and members of the press, walked along a part of Broadway they never were in before, *and more enjoyable than if they had been on the sidewalk of the well-known thoroughfare of the Empire City instead of twelve feet below it.*

An engraved invitation note asked those who had the good fortune to receive it, to attend an "Under Broadway Reception," at the office of the "Beach Pneumatic Transit Company," 260 Broadway, from two to six o'clock yesterday.

Descending an ordinary basement "dive," under Devlin's clothing store, *the visitors found themselves in a comfortable office, and a few steps lower there was a kind of Aladdin's cave opened to view, in which there was more to be seen than the eye could take in once, and therefore we must ask the reader's attention to a few particulars.*

First of all, let us explain the reason why descent was made into the bowels of Broadway, why all these important representatives of the pu had been asked to come and gaze and wor Legislative power has been obtained to constru pneumatic tube way from Warren street to C street, for the purpose of "blowing" small large parcels—indeed, all kinds of "express ness"—between these two localities. *The pro had not proceeded far with their work befo discovered that it would be very little more ex construct an underground railroad for the blo*

passengers as well as freight. Acting upon this hint, they have applied to the Legislature for power to construct this underground railroad; and if the calm, settled, and earnest approval of their plan by the representatives of the scientific and executive ability of the city be an earnest of their success, it will not be difficult to obtain the sanction of the Legislature to their bill. Virtually, therefore, yesterday's reception was the opening day of the first underground railway in America.

THE TUNNEL AND THE BORE.

The length of the tunnel already open is 294 feet; the iron portion of it is 57 feet; the brick, 237 feet. It is whitewashed and lighted with gas, has telegraphic wires running alongside the wall, is about 12 feet high, and formed a very pleasant promenade. The roar of the Broadway traffic was plainly heard overhead, and, until the ear got familiar with it, sounded very strangely. This 294 feet takes the tunnel to Murray street, on the south side, nearly flush to the Post-Office fence.

The visitor to the tunnel is shown very clearly how this tunnel has been made, and how it is that the work has been carried on in a mole-like manner without attracting the observation of the Broadway pedestrians, and without interfering in any degree with the traffic. Having first obtained an entrance from the surface in Warren street, and gone deep enough to be out of the way of sewers, gas and water pipes, a cylinder was introduced, which in shape resembled a barrel with the ends out, forced by 18 hydraulic rams. This forces itself through the earth, and to moderate the fall of the earth, a number of wooden shelves are placed within the cylinder for the earth to drop through; and as the earth deposits itself, it is shoveled up and carted away. In the course of the travels of this cylinder it came upon the remains of an old stone building, which was believed to be an old Dutch powder magazine. The stones were not too large to come through the shelves, and they were carted away with the earth. The cylinder has a projection in the front of it of steel, both broad and sharp, that finds no difficulty in cutting its way along. In the rear of it there is a thin piece of sheet iron, sixteen inches broad, upon which the brick work of the tunnel is built up; and when finished, the cylinder moves on again its earthy way, to have sixteen more inches of brick work added. To work this tunnel four men are required—two to work the rams and two to carry out the earth—and these men will drive a foot of earth in fifteen minutes. Two more men are required for the brick work.

THE MOTIVE POWER.

In this atmospheric system of propulsion, the "blower" takes the place of the locomotive, and the passengers and freight are literally blown to their destination. The term "blower" is used to designate a machine producing a blast having a positive force, and to distinguish it from a fan which does not produce a force-blast. In this respect a blower is analogous to cylinders used for producing blast. In either case the air forced must find an outlet or the machine must stop. But a fan can run with the outlet obstructed or entirely closed, without being in the least impeded.

The friction of the machine itself, in its operation, is so light that nearly the whole power applied to it is spent upon forcing the blast forward. Another important point of superiority in the blower is its great durability. Dust, which is invariably caused wherever there is agitation or a current of air, has no injurious effect whatever, as there are no slides or valves requiring oil, and liable to be soon coated over with dust when in operation. The blower is known as Root's Patent Force-Blast Rotary Blower, and the principle of it is greatly in use in the West, in all forges, instead of the old blacksmith's bellows. It is an Indiana invention, and is one of the few good things that come from that State. This blower is 21 feet high, 13 feet broad, and 18 feet long, and, with its appendages, occupies quite a suite of cavernous rooms, independent of the steam-engine and boiler house.

It is difficult in a verbal description to bring before the mind of the reader the mode in which the wind is raised by this blower. Looking at it over the brick walls that encompass it, two massive pieces of iron, that resemble wings, are seen, and these force the air, by rolling together, and produce a positive blast through the wings. The air is drawn in by one side of the blower and passes out at the other and into a duct that leads into the mouth of the tunnel under Broadway. This blower will deliver or exhaust the air in the tunnel at the rate of 120,000 cubic feet of air per minute, with sufficient force to carry a train of passengers.

The most ordinary observer can see that this is no ideal scheme; it is practical enough, and, but for a slight accident with the engine, the visitors might yesterday have been conveyed in the very elegant and comfortable passenger carriage from one end of the tunnel to the other. This carriage is admirably constructed, and was lighted with the new oxygen light, which is considerably clearer, purer, and more brilliant than the ordinary gaslight. The flame burns on a little pencil of "zircon," about a quarter of an inch long and the eighth of an inch in diameter. The oxygen and the hydrogen enter in separate tubes and impinge on the burner, producing the beautiful light described. It is likely to be of general use, and is now made by the New-York Oxygen Company, corner of Eleventh avenue and Forty-first street.

The train, when in motion, at certain places in the tunnel, communicates by electricity, by one of its wheels striking a copper plate on the rail, with a bell in the "blower" house, so that a valve may be turned, which reverses the current of air, by which the train is enabled to return to its destination.

As soon as the Legislature grant the necessary powers, the tunnel will be completed to Cedar street, then to every part of the city, and a more agreeable mode of traveling can scarcely be conceived.

After the first of March, the tunnel will be open to visitors on the payment of twenty-five cents, the profits of which will be devoted to the "Union Home and Schools for Soldiers' and Sailors' Orphans."

The visitors were much indebted to Mr. Alfred E. Beach, the President, and to Mr. Joseph Dixon, the Secretary, for the care both these gentlemen took in giving all needful explanations.

From the New-York Times, Feb. 27, 1870.

THE BROADWAY TUNNEL.

OPENING THE BORE TO PUBLIC INSPECTION—SUCCESS OF THE UNDERTAKING—GREAT CROWD OF VISITORS.

CERTAINLY the most novel, if not the most successful, enterprise that New-York has seen for many a day is the Pneumatic Tunnel under Broadway. A myth or a humbug it has hitherto been called by every body who has been excluded from its interior; but hereafter the incredulous public can have the opportunity of examining the undertaking and judging of its merits. *Yesterday the tunnel was thrown open to the inspection of visitors for the first time, and it must be said that every one of them came away surprised and gratified.* Such as expected to find a dismal and cavernous retreat under Broadway, opened their eyes at the elegant reception-room, the light airy tunnel and the general appearance of taste and comfort in all the apartments; *and those who entered to pick out some scientific flaw in the project, were silenced by the completeness of the machinery, the solidity of the work, and the safety of the running apparatus.*

The entrance to this tunnel is on Broadway at the corner of Warren street. At the bottom of the steps is the entrance to an office, and the apartment of the "rotary blower," a huge paddle-box-like affair, neatly frescoed on the outside. To the right a door leads into a long hall, down a few more steps, and directly under the Warren street sidewalk, which is the "depot" of the establishment, and is handsomely fitted up with a fountain, paintings, and seats. This hall opens toward Broadway to the tunnel, at the entrance of which stands a car ready for passengers. Adjoining the depot is the machinery for pumping the air in and out of the tube, which is worthy of an examination. The tunnel way itself, how it looks, how it is bored out, has been so often described in the various daily journals that only a brief account of it need be given here. The tube is eight feet in diameter, arched all the way round with brick painted white. From the bottom of it to the surface of Broadway is twenty-one feet, and it is therefore below all pipes and sewers. After curving around the corner of Warren street the tube is perfectly straight. On the bottom is a track about four feet wide. The car which runs upon this is about half as large as a street-car, cushioned, lighted, ventilated, and elegant in all its appointments. The contrivance that bores out the tubes is a huge iron cylinder, sharp at the end penetrating the earth, and is forced along by hydraulic pressure. The dirt is then shoveled out. So far—the tube now being complete 120 feet, or as far as the south side of Murray street—the excavation has been through sand only, and not a difficult matter. Yesterday the gentlemanly engineer of the company explained the whole construction of the tunnel, over and over again, to the visitors that kept coming and going.

Such, in brief, is a description of the various compartments of the mysterious underground Broadway tunnel, begun but a few months ago. The enterprise is controlled by the "Beach Pneumatic Transit Company," who propose to run their tunnels in every direction eventually, and make rapid communication between distant parts of the city. They claim that their cars can run one mile a minute with perfect safety by the pneumatic process.

The opening yesterday afternoon was a very pleasant "occasion." It was intended specially for dignitaries, legislators, aldermen, scientific men and members of the press, and scores of them were present. Mr. Beach himself was conspicuous, making his visitors explanations, and entertaining them like princes. Judge Daly, members of the American Institute, city officials, and many prominent citizens were observed among those who came. In the "depot," or reception-room, a first-class subterranean lunch was served continuously from two o'clock until six o'clock, and was continuously appreciated. The "health" of the tunnel was not forgotten. At nightfall, the unique occasion was over, but the "Transit Company" had made a host of friends and supporters.

The tunnel is to be open to the public every day from the first of March. The tickets of admission will be twenty-five cents, the entire proceeds to go to the Union Home for the Orphans of Soldiers and Sailors.

New-York World, Feb. 27, 1870.

THE PNEUMATIC RAILWAY.

PRIVATE INSPECTION OF THE WORK YESTERDAY—DESCRIPTION OF THE ROAD—THE TUNNEL TO BE THROWN OPEN TO THE PUBLIC IN A FEW DAYS.

YESTERDAY afternoon, the first section of the Pneumatic Railway under Broadway, beginning at the corner of Warren street and extending to the south side of Murray street, was opened for the inspection of members of the press and a large number of invited guests, including State officers, members of the Legislature, city officials, and many other gentlemen. On and after March first, the public will be admitted at a charge of twenty-five cents a head, the proceeds to be given to the Soldiers' Orphan Asylum. Any description of the Pneumatic Railway must necessarily be very imperfect; the work must be inspected to be thoroughly appreciated.

THE OUTER OFFICE.

Entering from the steps on Broadway, under the clothing store of Devlin & Co., the visitor finds himself in a light, airy apartment, 45 feet long and 12 wide, carpeted and fitted up in all respects like a first-class merchant's office; a part divided off for the occupancy of the presiding deity, and fitted with desk, office-stools, etc., the other part being f those having business with the officers of the co pany. At the further end of this room is seen t upper part of an immense cylinder, about 12 f long by 8 in diameter, and faced by a prett painted cog-wheel; and the visitor at once suppo that he sees the roof of the tunnel, and wond how he shall get in; but this he afterward c covers is a mistake, and that the cylinder that sees is only the casing to a large fan or blo which is the motive power of the cars.

THE SALOON.

Turning to the right, through a pair of hai folding doors, he finds himself in an elegant 120 feet long by 14 in width, the floor covere

f a pretty pattern, the walls hung with n expensive clock in the centre, elaborate s along the walls, comfortable settees at and at the further end a space railed off for ancy of the ladies, with one of Chicker- d pianos for their amusement while wait- › train. In the centre of this saloon, yes- as a table loaded with a very substantial which all were welcome, by the officers of ıny, and which served to concentrate the d permitted a more satisfactory inspection ınel and the working material of the road.

THE DEPOT.

end of this saloon is a flight of steps by passenger descends about six feet further und, and here is the platform of the depot,

THE CAR

ack. This car is cylindrical, made to fit l, and about 18 feet long, with seats nicely l, and is lit with the oxygen light.

THE TUNNEL.

front of the car is the entrance to the tun- s is a round tube of iron 8 feet in diameter long. It starts out from under the side- l curves to the middle of the street, and ıf brick, and straight for the rest of its The brick part is 257 feet long, making a ;th of 294 feet, which is as far as the com- e yet gone with their work, wishing merely ı working section for the approval of the at they may obtain the requisite permission Legislature to construct two such tunnels Broadway for its whole length. At present only permission to use a tube of 54 inches. ness of the masonry composing the tube is

THE BORING-MACHINE.

extremity of the tunnel is the boring-ma- d this consists of a cylinder 5½ feet in he outer rim of which is of heavy iron, aped, for penetrating the earth, and the in- lso heavy iron, and out of which play at ırvals short hydraulic rams. The two rims ıd together by staves like the staves of a Transversely in this cylinder are a series of hrough which the earth oozes slowly as the s pushed ahead of the rams, and thus pre- caving of the earth in front. To the inner ted a sheet-iron shield, 16 inches in length, supports the earth overhead as the cylinder forward. The power is communicated to by a hydraulic pump, which is worked by and as the rams are forced out against the ıonry behind, the cylinder is pushed for- When it has gone 16 inches, the power is n, the rams are forced in by levers, and pace of 16 inches is left, supported by the shield overhead. This is built up solid masonry of the tunnel, the power is again he apparatus is driven ahead another 16 his is again built up, and so on *ad infini- ıus* it will be seen that only the earth from eter of the tunnel is disturbed, and this ıe work of boring a most economical one. Four men are all that are required to work the machine, and they can advance 4 feet each day.

A ROCK AHEAD.

Sometimes a rock is encountered, and then the shelves have to be removed from the cylinder, and the rock is taken out through the open space thus left in the diameter of the cylinder. If the rock should happen to be too large for this, it is bored with a boring-machine moved by compressed air, and blasted to a size which will admit of the pieces coming through. The top of the tunnel is 12 feet below the surface of the street, and the whole distance to the bottom of the road-bed is 21 feet 4 inches. It is altogether below the sewers and other obstructions of the street, none of which will have to be moved, except about Canal street, for the whole proposed route of the railway. Gas-pipes are run through the whole length of the tunnel, and numerous jets make it as light of day. Electric wires also run all the way, and by a very ingenious arrangement the conductor can at any time signal to the engineer to stop the engine.

THE ENGINE.

Returning again along the tunnel to the depot, the visitor turns to the left through a door into the engine-room. The power is supplied to the engine by two of Miller's safety boilers, built by Joseph Miller & Co., of Boston. These are fifty horse-power each, nominal, but capable of working up to one hundred, with 48 feet of grate surface, and 1400 square feet of heating surface, and can raise sixty pounds of steam in twenty minutes, and the whole is included in a space of 20 feet by 10.

The engine is a stationary one of 75 horse-power, with 14 inch cylinder and 2 feet stroke.

THE BLOWER.

This moves the immense blower, the casing of which attracted the attention on entering the office; and this is placed at some distance from the engine, and is calculated to be driven at the rate of forty revolutions per minute, which will give 80,000 cubic feet of air per minute. It can be used either for forcing air into the tunnel, or exhausting it.

When the two tunnels are complete, and the road is in working order, it will exhaust from one, the place of which air will be supplied from the other, and then, reversing, will exhaust from the other, and be supplied from the first; thus, for instance, supposing the two tunnels completed as far as the first has gone, a car in Murray street in tunnel No. 1 and one in Warren street in tunnel No. 2, the air in No. 1 being exhausted, a pressure of fifteen pounds to the square inch is at once exerted at the back of each car, and the one moves up and the other down. Then reverse the process, and exhaust No. 2, and the motion of both cars is reversed. At present there is an air-hole overhead at the Murray street end, and the car is moved by forcing the air against it down the tunnel which escapes up this air-hole. Then the blower is reversed, and the air is exhausted in front, and rushing down the air-hole, propels the car on its return.

THE AIR-COURSES.

From and around this blower is an air-way or blow-pipe of great length, about 4 feet broad and 5

feet high, and it is through this that the air is driven to or drawn from the tunnel. There is also a large air-chamber alongside of the blower, where surplus air is stored.

THE STATIONS.

It is not contemplated to stop the cars except at the stations, and these will be wide, spacious chambers, emerging into which the air will be dispersed and the pressure taken off the car, which will enter these up an incline, which will serve to check its headway, and the brake will do the rest in bringing it to a stand-still. The brake is not applied to the wheels, but to a narrow wedge-shaped track in the centre of the roadway, down into which it is pressed by a lever, and grips it firmly, producing great friction, and arresting the motion instantly. Should it, however, be necessary to stop the car between stations, it can be done by opening a valve in the car, or opening the doors and allowing the air to pass through, or by signaling to the engineer.

THE OFFICERS.

The officers of the company are A. E. Beach, President; Joseph Dixon, Secretary; M. S. Beach, Treasurer, and Charles K. Graham, Consulting Engineer.

THE TIME OF CONSTRUCTION.

The whole time of construction of the 294 feet completed has been fifty-eight days and ten hours, and if the required permission be granted to the company to continue their road for the whole length of Broadway, many such sections can be gone on with at the same time, and the whole road speedily completed. Every one should invest a quarter in the inspection of this work, and they will be well repaid for the outlay. Owing to the breaking of an eccentric on the engine, it was impossible to show the working of the railway yesterday; but that will be remedied this week, and then all who visit the place may take a ride if they choose.

From the New-York Sunday Mercury, Feb. 27, 1870.

THE GREATEST OF OUR BORES.

UNDER BROADWAY—OPENING THE PNEUMATIC TUNNEL—FULL DESCRIPTION OF THE WORK—HOW THE EXCAVATION IS MADE—DISCOVERY OF ANCIENT RUINS—THE RAILROAD OF THE FUTURE—THE WORK TO BE CARRIED FROM THE BATTERY TO CENTRAL PARK.

Over a year ago, the papers announced that a company had begun tunneling Broadway for the construction of a pneumatic tube. When it was added that the work was begun under Devlin's store, at the corner of Broadway and Warren streets, all obtainable information was given; for the work was conducted with the greatest secrecy, and no one not known to be a workman in the employ of the company was allowed to pass the forbidden staircase. *Different papers have given different accounts of the enterprise, but the opening yesterday must have convinced them all of the powers of human imagination.*

The south-west corner of Broadway and Warren street was crowded yesterday afternoon. A sign over the basement door—"Broadway Pneumatic Transit Co." *—pointed the way to the new wonder;* but energetic policemen refused admission to all who were not provided with the necessary invitation ticket. Soon after two o'clock, the guests began to arrive, and the lower rooms were speedily filled with members of the press and Legislature, city officials, and prominent gentlemen of the town.

Passing through the basement door, we enter the office, which is more than half occupied by the blower. This blower is the vital part of the enterprise; for the air forced by it into and out from the tunnel will constitute the motive power. It can send out 1600 cubic feet of air per revolution, and can make sixty revolutions per minute. The air-chamber descends to the sub-cellar, where, on descending, we face the tunnel itself—a perfectly round opening, 8 feet in diameter, bearing off toward Broadway at an angle of about seventy degrees. The opening is arched, and neatly faced with bricks, and is surrounded with a circle of colored gas-jets. The tunnel, so far as completed, is 294 feet 6 inches long, of which 57 feet 6 inches are lined with iron, and the rest with brick. After the first 70 feet it becomes perfectly straight, and bears directly down Broadway. A car has been built, (as an experiment only,) and a light track has been laid, but a defect in the engine prevented its being put in motion yesterday.

Passing to the terminus of the opening, we involuntarily ask, "What digs?" All that meets the eye is a box-like arrangement, several iron tubes, and a little force-pump, small enough to be carried by one man. This, however, has done the work. The problem which the builders had to answer was, "How can we excavate this tube without opening or disturbing the street?" Digging would not do, since an opening less than 25 feet in circumference would allow little room for workmen. The method invented, and which has proved so successful, is as follows: A double iron cylinder, 5½ feet long, was placed against the earth. Between the plates of this were placed eighteen hydraulic rams, fed from the pump before mentioned. Placing two men at the handle, they obtain by this hydraulic pressure a power of 126 tons bearing on the opposing earth. The soil, being sand, would fall in one mass unless supported, so this cylinder is divided into fourteen compartments by means of shelves, and the sand trickles down between them. As soon as a headway of ten inches is made, the brickwork is continued, and made a prop for the further progress of the cylinder. Rocks are the principal source of annoyance; but when small, they pass out between the shelves; and if large, are removed with crowbars, by taking out the shelves entirely. When Murray street was reached, serious resistance was encountered; and, on removing the shelves, a clearly-defined wall was disclosed. It appeared, from the section made visible, like the wall of a fort, and must have been of very ancient construction. If the work is carried to the upper portion of the city, the rocks will be drilled out by means of compressed air, as is done in the Hoosic tunnel.

The top of the tunnel as built is 12 feet below the surface of Broadway, thus being entirely out of the way of gas-pipes, sewers, etc. Even at this distance the noise in the street is plainly audible, coming like the hum of a cotton-mill rather than a continuous rumble.

Thus far, then, the work is a success. A perfect tunnel, 8 feet in diameter and nearly 300 feet long, has been made under Broadway, in its busiest por-

tion, in fifty-eight days and ten hours working time, without disturbing travel or the street itself, and, in fact, without giving the public any idea of what was really in progress. But the company's charter allows them only to use a tube of 58 inches, and this for the transmission of packages. The original idea was to divide this tube into smaller ones to operate in both directions. But the success of the large tube has seemed to give an answer to the problem, *How shall an Underground Railway be constructed?* And the company will now go before the Legislature for permission to use their tunnel for the transfer of passengers, and to extend it from the Battery to Central Park, on each side of the street. *If this permission is obtained, over twenty openings will be made at once; and by working in each direction, the problem will soon be solved.*

To afford the public an opportunity of judging of the merit of the work, it will be open for exhibition to-morrow morning at a nominal admission fee. As the company can not appropriate these fees to its own use, they will be given in aid of the Union Home for the Children of Soldiers and Sailors.

From Harper's Weekly, March 12, 1870.

UNDER BROADWAY.

THE Pneumatic Tunnel, now in process of construction under the principal thoroughfare of New-York, commences in the sub-basements of the spacious marble building of Devlin & Co., corner of Broadway and Warren street, and extends, at present, to a point a little below Murray street. One of our illustrations on this page gives an interior view of the tunnel, looking south from near the entrance. It is eight feet in diameter, built of solid masonry, is dry and clean, painted white, and lighted with gas. The tunnel passes under all the gas and water-pipes and sewers: but, though so far below the surface of



THE TUNNEL.

the street, the rumbling of wheels and the tramp of horses overhead can be distinctly heard by one standing within it.

The tunnel is constructed by means of a shield, consisting of a strong cylinder, something like a barrel with both heads taken out. It is pushed forward by eighteen powerful hydraulic rams, and makes a



UNDER BROADWAY—A PASSENGER STATION.

bore of its own diameter through the sand. The loosened sand, as it falls through the rear end of the cylinder, is carried back through the tunnel in cars, and delivered upon an elevator on Warren street, where it is raised to the pavement and carted away. As fast as the cylinder advances, the tunnel is arched with masonry. By means of this machine, which was designed by Mr. A. E. Beach, the tunnel is pushed forward without any interruption to the business of Broadway.



UNDER BROADWAY—INTERIOR OF PASSENGER-CAR.

Another of our illustrations shows the mouth of the tunnel and a passenger car, as seen from the station, which is a nicely-finished underground apartment 120 feet in length, lighted from the Warren street sidewalk. Another illustration shows the interior of the passenger car, which carries eighteen passengers, has very comfortable seats, and is lighted with oxyhydrogen gas. The cars are to be propelled by the atmospheric system, consisting in driving through the tunnel a strong blast of presses against the rear of the car and along like a sail-boat before the wind. T rent of course secures perfect ventilation car. The air is driven into the tunnel b an immense blowing-engine operated by s Joseph Dixon, long known for his efforts the underground railway, is the superi the work.

As soon as the necessary authority tained from the Legislature, it is the inte company to proceed to construct a first-c ground railway, with large cars, to run f Ferry under Broadway to Central Park, that point; together with a Fourth Ave to Harlem River. They will be able, wh rangements are complete, to transport twenty thousand passengers per hour ea

New-York Post, February 26, 1870.

THE PNEUMATIC TUBE.

A RECEPTION UNDER BROADWAY

FOR the first time in the history of reception with all the accompaniments saloons, champagne and salads, was Broadway this afternoon.

The following invitation was issued ago:

UNDER BROADWAY RECEPTIO

To State Officers, Members of the Legislature, City Members of the Press:

You are respectfully invited to be present February 26th, 1870, from two to six o'clock P.M., the Beach Pneumatic Transit Company, 260 Broad Warren street. A. E. BEACH

JOSEPH DIXON, Sec.

Owing to the lateness of the hour, we give but a general outline of the enterpri

On descending the steps at the corne street and Broadway, the visitor finds h neatly oil-clothed room, on the left of wh the top of the rotary blower neatly pa vancing a few steps, the visitor turns to t descends three more steps, when he find a handsome and brilliantly lighted saloo centre is a fountain with jetting water an swimming in the basin. The ceilings a are hard-finished, and with neat stripin gas brackets, present an attractive appea floor is covered by oil-cloth, and the hung with damask curtains and cornices base is of alternate stripes of walnut and and about the room are arranged settee chairs. A piano also adds to the attra the apartment.

Having reached this floor, the guest t the City Hall Park, and descending anot steps, finds himself at the entrance of full view of the vast machinery to be u pelling the cars.

The top of the tunnel is surmounted b of pressed brick, over which are the lett man text, "Pneumatic (1870) Transit," a this is a row of gas jets, covered by alte of red, white, and blue. At either side, tal, are bronze figures upholding a clu lights.

e next feature which strikes the spectator is the ful curve of the tube into Broadway. The d arch is supported by iron plates, and after a ;ht line is reached, the tunnel is continued Broadway by arches of brick. The interior is ed white, and the entire length is lighted by The track is supported by a bracing of hard

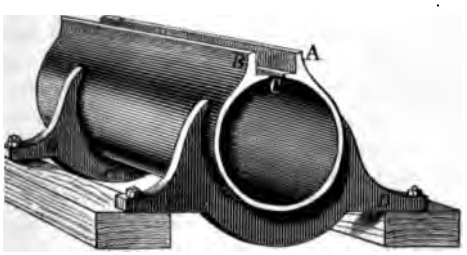
e present length of the tunnel is 294 feet and 6 s, and fifty-eight days and ten hours were con- d in constructing it. The track is 21 feet under urface of Broadway, and the only circumstance ı would indicate that the visitor is under a busy ughfare is the constant rumbling of vehicles ead. The car is built to conform to the shape e tunnel, being semicircular in form. It has ortable accommodation for twenty persons. The inery is of immense power, and of very fine manship.

e visitors to-day were handsomely entertained e officers of the company.

e tunnel will be thrown open to the public on rst day of March, from ten A.M. to four P.M., and emain open for several days. An admission of y-five cents will be charged, the proceeds to the Union Home for the Widows and Orphans ldiers.

ICH OF THE HISTORY OF THE SYSTEM OF PNEUMATIC TRANSIT.

1824, John Vallance took out a patent in Eng- for a method of propelling carriages through by atmospheric pressure, and in 1826 he had running on this plan. This attempt was suc- d by similar efforts by Messrs. Medhurst and ıs. The plan adopted by these gentlemen was ropulsion of the cars by means of a piston run-



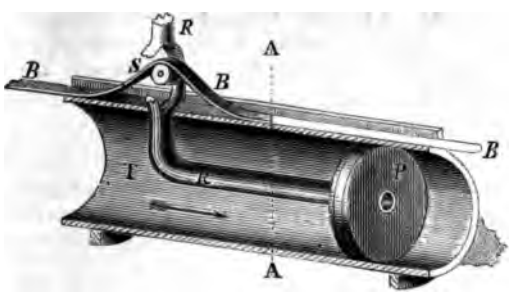
THE SLOTTED PNEUMATIC TUBE.

in a slotted tube; an arm projecting through lot, forming the point of attachment for the cars, ın endless band closing the slot both before and the arm, as shown in the engravings. The air n this method exhausted from the tube in front ı piston. This propulsion of cars was success- performed in this way, but the system is not at nt in use.

1842, W. H. James, C.E., promulgated his plan ıpid mail communication, which consisted in ling an atmospheric tube through which he proposed to propel balls, or, as he termed them, "hollow spheres," by atmospheric pressure. These balls were to contain letters, packages, and other freight; and the sanguine projector expected to re- alize a velocity of from three hundred to five hun- dred miles per hour. He claimed that tubes could be cheaply made, and that the balls would run with little or no friction. The plan attracted considerable attention, but nothing beyond the formation of a company and making of a few experimental models was ever done.

Vallance's system was again put in operation in 1861, by T. W. Rammell, in London, for carrying letters and packages, where pneumatic tubes, 2½ miles long and 3 feet in diameter, have been operated with success for the past seven years.

In 1864, a large tunnel for passenger-cars was erected at Sydenham, ¼ of a mile long, and thou-



THE SLOTTED PNEUMATIC TUBE AND VALVE.

sands of passengers were transported. This resulted in the incorporation of the Waterloo and Whitehall Railway, which is to extend from Charing Cross un der the Thames to the South-western Railway. The tunnels of this great pneumatic railway are 13 feet in diameter, and have been laid under the Thames em- bankment for a short distance under the river. The sub-river tunnel is built in iron sections, each 212 feet long, covered with brick, and sunk in a bed dredged out on the bottom of the river.

In this country, one of the earliest recorded efforts to introduce the pneumatic system was that of James Spicer, in 1832, who proposed to lay a series of tubes between New-York and Philadelphia, in five-mile sections, the vehicles to be operated by atmospheric power, each section being operated by two engines, one at each end, respectively, producing air compression and exhaustion. Mr. Spicer's first essay was to procure the indorsement of his plan by the Scientific Committee of the Franklin Institute of Philadelphia. He accordingly presented himself be- fore that body, and produced a working tube eigh- teen feet long, which operated with entire success. The learned committee reported that they regretted that Mr. Spicer should have incurred expenses in bringing his invention before the public, and then

proceeded to give various experimental proofs to show that the idea of driving the air through the tubes was *impracticable*. This was such cold comfort for Mr. Spicer that he proceeded no further. Considering that, a few years subsequent to Mr. Spicer's application, passenger-trains were run at the rate of sixty miles an hour in England by means of slotted atmospheric tubes, the conclusions of the committee are quite refreshing.

Public attention was next directed to the atmospheric system by Ithiel S. Richardson, of Boston, Massachusetts, who put a small tube, nearly one quarter of a mile long, into successful practical operation. He obtained patents, in 1853, for an atmospheric railway and telegraph. He expected to send the mails between Boston and New-York—two hundred and forty miles—in one hour. The aid of Congress was invoked for the building of an experimental line, but no appropriation was made.

In 1867, a tube of sufficient size for the transit of passengers was erected in the Armory building, Fourteenth street, New-York. It was operated by Mr. A. E. Beach, of the *Scientific American*. It was operated for several weeks, during the exhibition of the American Institute. The car carried fourteen persons, and about one hundred thousand visitors enjoyed the atmospheric ride. This is believed to be the first passenger pneumatic tube operated in this country.

In 1869, Mr. Albert Brisbane obtained a patent here for driving hollow balls or spheres through tubes by atmospheric pressure. This plan appears to be identical with that of Mr. James, 1842, before mentioned.

The present pneumatic tunnel under Broadway is the most recent work connected with the pneumatic system on this side the Atlantic. In England, France, and Belgium, small pneumatic tubes have for several years been in practical operation, chiefly for postal purposes.

TUNNEL PHOTOGRAPHS.

We are indebted to Messrs. Rockwood & Co., 839 Broadway, mechanical photographers, for a series of stereoscopic and other photographs illustrating the Pneumatic Railway under Broadway. As the works are entirely below the surface of the street, artificial light was employed, in the use of which the photographers have been very successful. The illumination was obtained by means of two large powerful oxyhydrogen calcium lights. Photogr has been brought to such perfection that ever bowels of the earth yield to it their mysteries Broadway has proved no exception. The pic were taken with the entire travel of the street, c bus, carts, carriages, and steam fire-engines, all ting directly over the head of the artist.—*Scie American*.

THE UNION HOME AND SCHOOL.

This excellent charitable institution was the to receive benefit by the opening of the Beach I matic Transit Company's works to the public. Union Home is designed for the education and t tenance of the children of volunteer soldiers sailors who may be left unprovided for. The Ho located at the corner of Eleventh avenue and Hundred and Fifty-first street, where large commodious buildings are now being prep capable of receiving six hundred children, boy girls.

Here they are cared for by the generous-hearte patriotic ladies of New-York, who look after thei fare with maternal solicitude, and befriend the orphans as much as possible. Besides the ord branches of education, the girls are instruct sewing and other domestic arts, while the boy exercised in military tactics, and taught a vari useful employments.

As fast as the children reach the proper age develop suitable capacities, homes and place found for them in shops and families, among p who take an interest in helping them along watching over their habits. They are not deli over as apprentices, so as to pass beyond the k and protecting influences of the Home; which tended to be, as its name indicates, a place of s in the time of need, where love and kindness their comforting power.

The Union Home is now under the especia tection and patronage of the Grand Army of th public of the Department of New-York. Its o embrace some of the most distinguished as w charitable ladies of New-York, among whom ar Charles P. Daly, President; Mrs. Admiral Far First Vice-President; Mrs. General Fremont, S Vice-President; Mrs. David Hoyt, Mrs. Clifford worth, Secretaries; Mrs. General Butterfield, sponding Secretary.

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